CORB'S CONTROL
OUTGOING LTR NO
94RF00323

DIST	LTR	ENC
BENEDETTI, R.L.		
BENJAMIN, A.		
BERMAN, H.S.		
BRANCH, D.B.		
CARNIVAL, G.J.		
COPP, R.D.		
DAVIS, J.G.		
FERRERA, D.W.		
HANNI, B.J.		
HARMAN, L.K.		
HEALY, T.J.		
HEDAHL, T.		
HILBIG, J.G.		
KIRBY, W.A.		
KUESTER, A.W.		
LEE, E.M.		
MANN, H.P.		
MARX, G.E.		
McDONALD, M.M.		
McKENNA, F.G.		
MONTROSE, J.K.		
MORGAN, R.V.		
POTTER, G.L.		
PIZZUTO, V.M.		
RILEY, J.H.		
SANDLIN, N.B.		
SHEPLER, R.L.		
STEWART, D.L.		
SULLIVAN, M.T.		
SWANSON, E.R.		
WILKINSON, R.B.		
WILLIAMS, S. (ORC)		
WILSON, J.M.		
ZANE, J.O.		
LAURIN	X	X
[illegible]	X	X
CORRES CONTROL	X	X

CLASSIFICATION:

UCNI		
UNCLASSIFIED	X	
CONFIDENTIAL		
SECRET		

AUTHORIZED CLASSIFIER SIGNATURE

DOCUMENT CLASSIFICATION REVIEW WAIVER PER CLASSIFICATION OFFICE

ATE

N REPLY TO RFP CC NO

CTION ITEM STATUS
☐ OPEN ☐ CLOSED
☐ PARTIAL

TR APPROVALS
JL. 1/12

RIG & TYPIST INITIALS
PJL:jlm

-6469 (Rev 9/92)

EG&G ROCKY FLATS

EG&G ROCKY FLATS, INC
ROCKY FLATS PLANT, P O BOX 464 GOLDEN, COLORADO 80402-0464 • (303) 966 7000

000021834

January 7, 1994

94-RF-00323

Jennifer L Pepe
Environmental Restoration Division
DOE, RFO

TRANSMITTAL OF MEETING MINUTES – PJL-002-94

Attached for your review are minutes from the meeting held with the Environmental Protection Agency (EPA) and the Colorado Department of Health at the EPA's Eagle Conference Room on December 23, 1993 Please call me at 966-8702 if you have questions

Peter J Laurin
Operable Unit 2 Project Manager
Remediation Project Management

jlm

Orig and 1 cc – J L. Pepe

Attachment
As Stated

ADMIN RECORD

A-0006-000301

MEETING MINUTES CMS/FS PROGRAMMATIC TASKS

DATE December 23, 1993, 9am

LOCATION. EPA Eagle Room, Denver

ATTENDEES Hopkins, Guillaume, Schubbe, Laurin, of EG&G, B Frasier of EPA, Norbury of CDH, Grace, Dille, Greengard representing DOE, and Shangraw, Gee of Engineering-Science

NARRATIVE An agenda for this meeting was provided by DOE and is attached to the minutes, as are all hand-outs The items discussed follow the agenda generally

Agenda Item 1, Introduction, was conducted by Scott Grace of DOE. Grace stated that DOE would like to discuss FS schedules, especially the OU2 schedule

John Hopkins of EG&G lead the Item 2 discussions He stated the purpose of the meeting was to initiate an information exchange between EPA, CDH and DOE on FS policies and procedures. The programmatic approach, beginning with OU2, will promote consistency in the FS process. Programmatic aspects to discuss include deliverables and schedules. Hopkins also stated they would like to identify FS leads at EPA and CDH to serve as prime contacts in the programmatic aspects (Later in the meeting, EPA stated B Frasier would serve as FS contact Norbury of CDH postulated that Schiefflin would likely be the CDH FS lead)

Agenda Item 3, the Programmatic Approach was delineated by Hopkins and Greengard. The task-by-task FS approach was handed out and discussed EG&G requested that ultimately a documented agreement on the FS procedures and approach could be developed with EPA, CDH and DOE. EG&G's intent is to avoid situations similar to the risk/statistic problems on the RIs. As illustrative of the Programmatic Approach, ES staff presented the Task 3 work underway The Comprehensive List of Technologies format was handed out and discussed. The Sitewide Treatability Studies was the basis for this work OU1 will be included in the Programmatic efforts as possible (they are currently slightly ahead of this)

Agenda Item 4 covered the Proposed EPA Radiation Site Cleanup Regulations In response to DOE inquiry, EPA responded that the schedule for these regulations is completely unknown at this time DOE's concern was proceeding with FS work only to fall under additional regulations at some later date

The second ongoing FS issue (Item 4) was the interaction between OU1 and OU2 Surficial soil remediation of radionuclides may be required at both sites DOE would like to consolidate the FS work when possible to avoid redundant efforts EPA recommended the FS effort on OU1 carry through the initial screening process If like remediation is

required at adjacent sites, DOE could then propose that a combined detailed analysis of alternatives be conducted as part of OU2

The final agenda item included scheduling of a January 6 meeting to present a detailed schedule of OU2 FS work That meeting will be January 6, at 9am in the Eagle Room at EPA.

AGREEMENT/CONSENSUS DECISIONS:

1 DOE will use a "Programmatic Approach" for OU's 2, 3 and 6 to ensure consistency between each OU's FS work The programmatic methodology will be defined with agencies The programmatic approach will ensure all OU's meet the requirements of the FS process.

2 DOE will submit an FS planning document which will explain and formalize the programmatic methodology

3 The OU1 FS process is well underway If it becomes necessary to address Pu remediation in OU1 surficial soils, the OU1 FS process will be completed through initial screening of alternatives At that time, DOE may propose to EPA to complete the Detailed Analysis of OU1 surficial soils as part of the OU2 Detailed Analysis The rationale is that similar/like remediation technologies at adjacent sites should be consolidated to maximize efficiencies and best utilize resources

4 DOE will present a preliminary detailed OU2 CMS/FS schedule to EPA and CDH on January 6, 1994

ACTION ITEMS:

1 DOE will prepare an FS planning document for submittal to EPA and CDH

2 DOE will prepare and submit a detailed OU2 CMS/FS schedule Submittal will take place via a meeting on January 6, 1994

Attendance

Dec 23

CMS/FS

Name	affiliation	Phone
Cindy Gee	ES	831-8100
Michael Guillaume	EG+G	966-8557
Pete Laudrin	EG x G	966-8702
Eric Dilke	Aquire Eng / DOE	966-4651
Scott Grace	DOE/ER	966-7199
Bill Fraser	EPA	294-1081
TOM GREENGARD	SMS-RFD	966-3677
Dennis Schubbe	EG&G	966-8709
John Hopkins	EG&G	966-8636
Dave Norbury	CDH	697 3415
Tim Shanahan	Engineering - Science	831-8100

AGENDA FOR DISCUSSION OF PROGRAMMATIC
FS/CMS ISSUES - ROCKY FLATS PLANT

DATE:DECEMBER 23,1993
TIME: 9 AM
LOCATION:U.S. ENVIRONMENTAL PROTECTION AGENCY

AGENDA ITEMS

1. INTRODUCTIONS

2. PURPOSE OF MEETING

3. PROGRAMMATIC APPROACH TO FS/CMS

4. FS/CMS APPROACH (PLANNING DOCUMENT)

5. CURRENT FS/CMS ISSUES

   - What is EPA's timetable for proposing Radiation Site Cleanup Regulations? Reference EPA 402-R-93-084, September, 1993, Issues Paper on Radiation Site Cleanup Regulations.

   - Discuss potential of moving surface soil plutonium in OU1 to OU2

6. ACTION ITEMS

   - Establish date and location for mid January meeting to review a programmatic schedule/logic diagram for the FS/CMS process.

   - Schedule dates and agenda items for OU1 and OU2 specific FS/CMS meetings

9 December, 1993

DRAFT FEASIBILITY STUDY/CORRECTIVE MEASURE STUDY ANNOTATED OUTLINE ROCKY FLATS PLANT

EXECUTIVE SUMMARY

1.0 Introduction

1.1 Purpose and organization of FS/CMS Study

The purpose of the FS/CMS follows:

- Develop a range of remedial action alternatives with respect to protection of human health and the environment, technical, institutional and cost considerations.

- Provide an analysis of the range of remedial alternatives developed that will support the selection of a remedial alternative(s) that is technically feasible and provides the necessary protection of human health and the environment in a cost-effective manner.

- Integrate the FS/CMS with all applicable RI/RFI and treatability study activities to ensure that all remedial alternatives are developed, screened, and evaluated in a systematic manner.

The FS/CMS report will be prepared at a minimum in accordance with U.S. EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (October 1988), EPA CERCLA Compliance with Other Laws manual (June, 1988), OSWER Directive 9234.1-01 and "EPA Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites" (August 1988).

1.2 Background Information (Summarized from RI/RFI Reports)

1.2.1 Site Description

1.2.2 Site History

1.2.3 Nature and Extent of Contamination

- Summarize the nature and extent of contamination within each medium. Discuss contaminants of concern.

- Summarize the nature of contamination within each medium by functional group.

- Discuss the extent of contamination within that medium.

1.2.4 Contaminant Fate and Transport

A summary of the fate and transport mechanism for contaminant migration by medium will be presented. This discussion will include the following:

- A discussion of the directions and rates of groundwater, surface water and air flow.

- A summary of the distribution of contaminant concentrations, if any, over time in the groundwater and surface water.

- A summary of the contaminant concentrations in air and the distribution of these concentrations with distance.

1.2.5 Summary of Baseline Risk Assessment

The BRA will provide an evaluation of the potential risk to human health and the environment in the absence of any remedial action. The Following information will be summarized from the BRA.

- Identification of the potential risk associated with the chemical and/or radionuclide hazard at the Operable Unit (OU). This includes determination of chemical concentrations and potential pathways of exposure to humans.

- Evaluation of the exposure to a chemical substance; i.e. concentrations at which exposure may occur to human health or environmental receptors via air, water, soil, or through the food chain.

- Environmental fate of the chemical substance; i.e. the potential for change and transport of a substance through the environment.

- Assessment of the resulting effect and evaluation of the hazard or potential adverse effects associated with a chemical; i.e. its toxicity

- Risk estimation, including compilation and analysis of the information obtained from the above evaluations to determine the consequences that can be anticipated following exposure to a hazard at the OU.

1.2.6 Summary of Interim Measures/Interim Remedial Actions

2.0 Identification and Screening of Technologies

2.1 Introduction

- Generate a list of candidate technologies for the Ou that may be used in assembling plausible remedial action alternatives.

- Screen technologies based on site and waste characteristics and effectiveness of the technology for application to the waste medium.

2.2 Remedial Action Objectives

- Identify contaminants of concern as identified in the BRA

- The exposure pathway assessment, toxicity assessment, and risk characterization for the contaminants of concern will be used to develop PAOs for each medium

- Develop RAOs specifying the contaminants and media of interest, exposure pathway and remediation goals.

- Calculate PRGs based on ARARs and the BRA process.

2.3 General Response Actions

- Develop general response actions for each medium of interest including no action, institutional controls, containment, removal, treatment and disposal.

- Estimate the area and volumes to which general response actions may be applied.

2.4 Identification and Screening of Technology Types and Process Options.

2.4.1 Identification of Technologies Associated with the General Response Actions

General Response Action	Example of Technologies
No Action	None
Institutional Controls	Access restrictions, monitoring

Containment	Capping, vertical barriers, horizontal barriers.
Removal	Bulk liquid, solids removal, ground-water extraction
Treatment	Physical treatment, chemical, biological, in-situ, thermal
Disposal:	Onsite or offsite storage in RCRA permitted area or RCRA certified landfill, POTW discharge, evaporation ponds

2.4.2 Screening of Technologies

- Eliminate technology types based on technical implementability

2.4.3 Selection of Representative Technologies

- Identify technology types and process options by utilizing a variety of sources including evaluation of technologies previously performed for the site, referenced developed for application to Superfund sites, and standard engineering texts.

3.0 Development of Alternatives

3.1 Introduction

- Develop a range of remedial action alternatives that include the following as specified in the National Contingency Plan (NCP).

- No action

- Treatment options that will eliminate or minimize to the extent feasible, the need for long-term site management

- Treatment options that reduce the toxicity, mobility, or volume of the media as a principal element

- Containment options utilizing little or no treatment

3.2 Alternative Analysis

Each alternative analysis will include the following:

- A brief description of the remedial alternative

- An evaluation and selection based on short term and long term aspects of three broad criteria:

  . Effectiveness
  . Implementability
  . Cost

3.3 Summary of Initial Screening of Alternatives

- Present the results of the initial screening of alternatives in flow chart, table and/or text format

4.0 Detailed Analysis of Alternatives

4.1 Introduction

- A detailed analysis will be conducted for each of a limited number of alternatives that represent viable approaches to remedial action

4.2 Analysis of Alternatives

- The detailed analysis will consist of a narrative discussion of individual alternatives with respect to the nine evaluation criteria specified in the NCP

4.2.1 Alternative Definition

4.2.1.1 Detailed Description of Each Remedial Alternative

- Describe each technology and how it will be integrated with other technologies for each remedial alternative. A preliminary engineering design will be presented for each alternative.

4.2.1.2 Assessment

- Each of the remedial alternatives will be evaluated based on the following nine criteria. The NCP requires that all alternatives meet two threshold criteria.

Threshold Criteria

- Compliance with ARARs - This assessment against this criterion describes how the alternative complies with ARARs, or if a waiver is required, how it is justified. This assessment will also address other information from advisories, criteria, and guidance from the EPA and support agencies that they have agreed is "to be considered"

- Overall Protection _ This criterion will access the alternative as a whole and address if it achieves and maintains protection of human health and the environment

Balancing Criteria

If the threshold criteria are satisfied, then five sets of "Balancing Criteria" are developed against which to compare the alternatives.

- Short-Term Effectiveness. This criterion will be examined based on the effectiveness of the alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met

- Long Term Effectiveness and Permanence - This criterion will be examined based on the effectiveness of the alternatives in maintaining protection of human health and the environment after response actions have been met

- Reduction of Mobility, Toxicity and Volume (MTV) through Treatment. This criterion evaluates the anticipated performance of the specific treatment technologies in permanently and significantly reducing the MTV of the hazardous substances.

- Implementability. This assessment will evaluate the technical and administrative feasibility of alternatives and the availability of goods and services.

- Cost. This assessment evaluates the capital and operation and maintenance (O&M) costs of each alternative.

Modifying Criteria

Two additional "Modifying Criteria" are specified in the NCP, which are a third tier upon which to compare alternatives.

- State Acceptance. This assessment will reflect the State of Colorado's preference among or concerns about alternatives.

- Community Acceptance. This assessment will reflect the community's preference among or concerns about the alternatives.

4.2.2 Summary of Analysis of Alternatives

- A summary of results of the detailed analysis of the remedial alternatives will be presented in the format of text, tables and flow charts.

5.0 Comparison Among Alternatives

- A comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criteria. The advantages and disadvantages of each alternative relative to one another will be identified. A Summary of the comparisons among alternatives will be presented in text, tables, and/or flow charts

6.0 Recommended Remedy

- The recommended remedy will be presented based on the analyses in Sections 4.0 and 5.0.

Bibliography

Appendixes

- Appendixes will contain documentation to back up specific sections. For example, details of cost analyses, ARARs rationale and back-up data for computer modeling will be presented in an appendix.

December 21, 1993

DRAFT

FS/CMS APPROACH

TASK 1 EVALUATION OF DATA SUFFICIENCY

Objective: Review available RI/RFI data, treatability study information and vendor information and determine where data insufficiencies exist and propose activities which could reduce the uncertainties to levels consistent with DQOs for each decision area.

Criteria for Data Sufficiency Review:

1) Are additional treatability studies required?
2) Are pilot-scale studies required to refine cost information or to further assess the effectiveness of the technology?
3) Can volumes and areal extent of contaminated media be delineated?
4) What are specific concentrations and types of contaminants in media?
5) Is contamination in media discrete or homogenous?
6) Are other constituents of media known (constituents that may interfere with or enhance a remediation technology)?
7) Are sufficient soils data and aquifer data available to evaluate technology/process options and groundwater modeling?

Key Decisions:

1) If data gaps are identified, does the cost of acquiring the data outweigh the cost of proceeding with the uncertainties?

2) Can bench or pilot-scale studies be put off until remedial design?

3) What type of groundwater modeling will be required. Will the BRA model have to be revised (e.g. Is the grid size correct?). If pump and treat scenarios are evaluated, how will well spacings be determined.

Relation to Other Tasks:

1) RI/RFI reports - The Nature and Extent of Contamination section of the RI/RFI report must be complete.
2) Treatability Studies - data on specific technologies will be reviewed to see if there is sufficient information to determine a technology's effectiveness and capital and O&M cost
3) Strategic Planning - Will OU specific media be combined and treated with material from other OUs, thereby reducing overall costs?

TASK 2 REVIEW OF ARARs

Objective: Perform a critical review of potential applicable or relevant and appropriate requirements (ARARs) and perform a preliminary ARARs assessment considering site specific factors (i.e., hydrogeology, contamination, migration pathways, etc.) as well as regulatory issues established by DOE Orders, U S EPA, CDH, the Atomic Energy Act, and related statutes and guidelines.

Criteria for Review of ARARs

1) Meet with ARARs Coordinator to discuss ARARs strategy and obtain latest ARARs documents, e.g. Site-wide Benchmark Tables.
2) Determine if there is sufficient information to prepare preliminary action and location specific ARARs.
3) Schedule sufficient review time with ARARs Coordinator for EG&G and DOE ARARs review.

Key Decisions:

1) Can FS/CMS work proceed independently of ARARs resolution with Agencies?
2) At what point in the OU FS/CMS process will action and location specific ARARs be prepared?
3) At what point in the OU FS/CMS process will ARARs be updated?

Relation to Other Tasks:

1) Preliminary Remediation Goals - determination of chemical-specific ARARs will be required to finalize PRGs.
2) Evaluation Criteria (FS/CMS Phase 2) - Alternatives have to be evaluated against ARARs. If ARARs cannot be met for a preferred remedy, then a waiver must be applied for.

TASK 3 IDENTIFICATION OF TECHNOLOGIES

Objective: A Comprehensive List of Technologies/Process Options has been developed on a Programmatic Basis for use in all OU FS/CMSs. The CLT will be used to present information on an OU specific basis on technologies and process options to facilitate an analysis of the applicability of a technology or process option.

Criteria for Identification of Technologies

1) The CLT developed under Task 3 will be the basis for screening of technologies and process options under Task 6.

2) The programmatic CLT will be updated, if required, for each OU FS/CMS

3) In addition to using the Programmatic CLT, a review of innovative technologies will be conducted for specific applicability for each OU.

TASK 4 DEVELOP REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS AND PRELIMINARY REMEDIATION GOALS

Objective: Remedial action objectives (RAOs) will be developed for each OU and media specific preliminary remediation goals will be developed to meet the RAOs. General Response Actions (GRAs) will then be developed that describe the initial areas and volumes to be remediated based on the PRGs for each OU.

Criteria for developing RAOs, GRAs, and PRGs

1) If the baseline risk assessment(BRA) has been completed, develop PRGs based on the BRA.

2) If the BRA has not been completed, use the draft or final COC TM and calculate a limited number of PRGs according to EPA RAGs guidance (Part B) and also use the Sitewide Benchmark tables. Revise PRGs when the BRA has been finalized.

Key Decisions:

1) Should PRGs be calculated based on the BRA or initially based on the COC TM and then updated to reflect the BRA. The second approach will allow an earlier start on Task 6 and subsequent tasks.

Relation to Other Tasks:

1) RFI/RI Reports - The Chemicals of Concern TM of the RFI/RI report must be complete.

Task 5 TECHNICAL MEMORANDUM 1 - CORRECTIVE/REMEDIAL ACTION OBJECTIVES

Objective: A Technical Memorandum will be prepared per Section IX.A.4, Attachment 2 of the IAG to propose site-specific corrective/remedial action objectives.

Criteria for TM1: TM1 shall contain the following:

1) the contaminants and media of interest
2) the volumes and areas of such media
3) exposure pathways and receptors
4) risk-based PRGs
5) the methodology used to develop PRGs

Key Decisions:

1) EPA and CDH will review and comment on TM1. Can work start on Tasks 6 and 7 before resolution of comments on TM1?

Task 6 INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

Objective: Applicable technologies (including innovative technologies) will be screened based on site-applicability as well as PRGs and ARARs for each specific OU.

Criteria for the initial screening of technologies and process options:

1) The CLT will be tailored to each OU based on site-applicability (media to be cleaned up, and physical/infrastructure requirements
2) The information used for site applicability will be the OU data from the EDS report
3) The OU specific technology will then be matched against the PRG/ARAR requirements of that OU.

Key Decisions:

1) Can work start on Task 6 before resolution of comments on TM1?

Task 7 ASSEMBLE THE REPRESENTATIVE TECHNOLOGIES AND PROCESS OPTIONS INTO ALTERNATIVES

Objective: Representative process options will be assembled into alternatives that represent a range of treatment and containment alternatives as specified in the National Contingency Plan.

Criteria for assembling the representative technologies and process options into alternatives:

1) The range of alternatives for each OU shall include the range of alternatives specified in the NCP.
2) Each alternative will be described based on preliminary sizing of unit operations considering the proposed volume of contaminated media.

Key Decisions:

1) If a similar contaminated media exists in another OU, can the media be combined for treatment or containment?
2) Is the range of alternatives assembled for initial screening complete? EPA and CDH concurrence is critical at this point.

Relation to Other Tasks:

1) Information on the Site-wide treatability study program and on innovative technologies should be reviewed at this point.
2) ARARs and PRGs should be updated at this point

TASK 8 SCREENING OF ALTERNATIVES

Objective. The goal of this screening is to ensure that only alternatives with the most overall benefit,based on an evaluation

of the three criteria specified in the National Contingency Plan, are retained for detailed analysis

Criteria for the Initial Screening of Alternatives:

1) Each alternative developed in Task 7 will be screened against three criteria: effectiveness, implementability and relative cost.
2) A rational basis will be presented for retaining or not retaining an alternative for detailed analysis.

Key Decisions:

1) Concurrence on the level of detail required to support the initial screening (e.g. is groundwater modeling required in the initial screening or in the detailed analysis of alternatives?
2) Concurrence on the list of alternatives to be carried into the detailed analysis of alternatives.

TASK 9 TECHNICAL MEMORANDUM NO.2 - PRELIMINARY ALTERNATIVES DEVELOPMENT AND SCREENING

Objective: A Technical Memorandum will be prepared per Section IX.B of the IAG to summarize development and initial screening of alternatives.

Criteria for TM2: TM2 shall contain the following:

1) A summary of the results of Tasks 6,7,and 8.
2) Summarize the rationale used in the screening process
3) List the alternatives to be carried forward into the detailed analysis of alternatives.
4) Propose action-specific ARARs for the alternatives that remain after the initial screening of alternatives.

Key Decisions: EPA and CDH will review and comment on TM2. Can work start on Tasks 10 and 11 before resolution of comments on TM2?

TASK 10 DETAILED ANALYSIS OF ALTERNATIVES

Objective: To evaluate remedial alternatives so that relevant information regarding the remedial alternatives can be presented to a decision maker and an appropriate remedy can be selected.

Criteria for the detailed analysis of alternatives:

1) Provide a detailed description (preliminary engineering design) of each alternative that outlines the waste management strategy involved.
2) Evaluate each alternative against the nine criterion specified in the NCP.
3) Provide a detailed analysis of the costs versus risk reduction/benefit of each alternative. This analysis will be based on the cost of each alternative to attain ARARs and risk based remediation goals across the lifetime added cancer risk range of

1 x E-4 to 1 x E-6 The analysis will evaluate the cost versus risk reduction/benefit of alternative remediation requirements based on the range of plausible baseline risks detailed in the BRA
4) A comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criteria.
5) A preferred alternative will be identified that considers the requisite nine criteria analysis as well as the cost versus risk/benefit versus the risk/benefit assessment.

Key Decisions:

1) What are the requirements for long term monitoring? These will be detailed and costed for each alternative.
2) What is the extent of groundwater modeling required to support the detailed analysis of alternatives?
3) How will requirements for NEPA compliance be integrated with the detailed analysis of alternatives? Will they be addressed under Short Term Effectiveness or in a separate document?
4) What indirect costs will be added to the construction cost estimate to reflect the real cost of remediation.

TASK 11 FS/CMS REPORT

Objective: A FS/CMS report will be prepared per Section 1.X.D.1 of the IAG to describe and substantiate the rationale behind all findings and summarize all findings into a concise format to facilitate communication with technical and non-technical audiences.

Criteria for the FS/CMS Report

1) The main text will present an orderly description of the FS/CMS development. Detailed technical work such as risk reduction methods, groundwater modeling and costing shall be presented in stand-alone appendices.
2) An executive summary section will be prepared that forms the basis for the Proposed Remedial Action Plan.

Instructions for Entering Data into the Rocky Flats Comprehensive List of Technologies

dBASE® IV has been utilized to organize a database containing information on Process Options. There are nine files on the diskette provided under the file name DE324 XXX To operate the database, load all files into a RUST dBASE® IV catalog Please utilize the data column to input new information and the reports column to print out the database for quality assurance/quality control purposes.

Note Memo fields are stored in a second database
To open a memo field type Control Home
To close a memo field type Control End
The field names and information needed for each field are as follows
(please be sure to close the memo field at the end of the last word without hitting the carriage return)

```
Structure for database: C:\DBASE\CLTDB\DE324.DBF
Number of data records:     109
Date of last update    : 12/16/93
Field  Field Name  Type       Width     Dec     Index
    1  ENTRY_NUM   Numeric        4                 Y
    2  MEDIA       Character      4                 Y
    3  RESPONSE    Character      3                 Y
    4  TECHNOLOGY  Character     30                 Y
    5  PROCESS_OP  Character     40                 Y
    6  DESCRIPT    Memo          10                 N
    7  METALS      Logical        1                 N
    8  PCBS        Logical        1                 N
    9  RADS        Logical        1                 N
   10  VOCS        Logical        1                 N
   11  SVOCS       Logical        1                 N
   12  OTHER       Logical        1                 N
   13  SPEC_CONTA  Character     50                 Y
   14  EFFECTIVE   Memo          10                 N
   15  IMPLEMENT   Memo          10                 N
   16  COST        Memo          10                 N
   17  REFERENCE   Memo          10                 N
   18  VENDOR      Memo          10                 N
   19  DATA_NEEDS  Memo          10                 N
   20  COMMENTS    Memo          10                 N
** Total **                     218
```

Entry Number

Number each record entered into the database Entry numbers should be categorized as follows

100-199 Aboveground water
200-299 *In-situ* ground water
300-399 *In-situ* surface water
400-499 Aboveground sludges
500-599 *In-situ* sludges
600-699 Aboveground soils and sediments
700-799 *In-situ* soils and sediments

Media

Enter the acronym representing the media in which the process option is applicable

Aboveground Water	ABGW
In-situ Ground water	ISGW
In-situ Surface Water	ISSW
Aboveground Sludges	ABSL
In-situ Sludges	ASSL
Aboveground Soils and Sediments	ABSS
In-situ Soils and Sediments	ISSS

General Response Action

Enter the acronym representing the General Response Action in which the process option is to be categorized

Containment	CMT
In-situ Treatment	IST
Removal	RML
Disposal	DSP
Aboveground Treatment	AGT

Technology Type

Enter the technology type in which the process option is to be categorized (e g , chemical treatment, physical treatment, thermal treatment, etc)

Process Option

Enter the name of the specific process option (vendor name if process is unique to vendor)

Description

Description of specific Process Option

Applicable Contaminants

Select a Y=Yes or N=No if the group of contaminants is applicable to the Process Option

Metals	M
PCB/pesticides	P
Radionuclides	R
VOCs	V
SVOCs	S
Other	O

Specific Contaminants

List of specific compounds which are applicable to the Process Option

Effectiveness

Address the following issues in order, if applicable to the Process Option (Note Precede each issue with a hyphen, then use a carriage return upon completion of answering each separate issue)

- Residual treatment level/removal efficiency
- Additional processes or secondary treatments required
- Effects of site conditions on process effectiveness
- Reductions in toxicity, mobility or volume
- Short term and long term effectiveness

Implementability

Address the following issues in order, if applicable to the Process Option (Note Precede each issue with a hyphen, then use a carriage return upon completion of answering each separate issue)

- Equipment availability
- Process proven/established or innovative
- Installation/O&M requirements
- Pilot, bench or process scale testing required or performed historically
- Regulatory/public acceptance
- Effects of site conditions on implementation process
- Time restraints

Cost

List available cost data, for example

- Order of magnitude
- Unit rates (with volume scale up factor e g , $1 to $3 5/pound, rate decreases 10% with each additional 50 lbs)
- Capital
- Operations and maintenance

References

Sources of Information (e g , databases, technical papers)

Vendors

Vendors providing equipment and services for specific Process Options (For numerous vendors offering equipment and services for the same Process Option, please limit the list to 50 characters or five vendors, which ever is satisfied earliest)

Comments

Comments may include additional information to further clarify previously stated information or which is not appropriate to the categories above

Bibliography

Provide a list of references in alphabetical order as follows

Authors last name, first name year *title of book or journal*, title of article (if appropriate), publishing company, publishing city, state, month.

ENTRY NUMBER	162
MEDIA	ABGW
GENERAL RESPONSE	AGT
TECHNOLOGY TYPE	PHYSICAL TREATMENT
PROCESS OPTION	SOLAR DETOXIFICATION
DESCRIPTION	CONTAMINANTS ARE BROKEN DOWN INTO NONTOXIC COMPOUNDS BY EXPOSURE TO SUNLIGHT AND MIXTURE WITH A NONTOXIC CATALYST (T1O2)
METALS	N
PCBS	N
RADIONUCLIDES	N
VOCS	Y
SVOCS	N
OTHER	N
SPECIFIC COMPOUNDS	TCE
EFFECTIVENESS	- DEMONSTRATION TEST RESULTED IN TCE DESTRUCTION TO NONDETECTABLE LEVELS - PROCESS BYPRODUCTS INCLUDE CARBON DIOXIDE, CHLORIDE IONS, AND WATER - SECONDARY TREATMENT MAY BE REQUIRED FOR USED CATALYST MATERIAL - REDUCES TOXICITY OF WASTE STREAM
IMPLEMENTABILITY	- EQUIPMENT NOT READILY AVAILABLE - INNOVATIVE PROCESS, NOT WELL-ESTABLISHED - INSTALLATION AND O&M REQUIREMENTS UNKNOWN - FIELD DEMONSTRATION UNIT WAS CAPABLE OF TREATING OVER 7,000 GAL/DAY - PERMITTING AND PUBLIC ACCEPTANCE NOT ESTABLISHED
COST	NO COST DATA FOUND IN REFERENCES
REFERENCE	FEDERAL DEMONSTRATIONS, EPA 1993B TSP, EG&G 1991
VENDOR	NO VENDORS IDENTIFIED
COMMENTS	

ENTRY NUMBER	163
MEDIA	ABGW
GENERAL RESPONSE	AGT
TECHNOLOGY TYPE	BIOLOGICAL TREATMENT
PROCESS OPTION	BIOLOGICAL SORPTION
DESCRIPTION	ALGAE OR OTHER BIOMASS (E.G., SPHAGNUM PEAT MOSS) IS USED TO REMOVE HEAVY METAL IONS FROM AQUEOUS SOLUTION SIMILAR TO ION EXCHANGE RESINS
METALS	Y
PCBS	N
RADIONUCLIDES	Y
VOCS	N
SVOCS	N
OTHER	N
SPECIFIC COMPOUNDS	AL,CD,CR,CO,CU,PB,HG,UR,ZN
EFFECTIVENESS	- HIGH REMOVAL EFFICIENCIES HAVE BEEN DOCUMENTED - GREATER EFFICIENCIES ACHIEVED BY RECIRCULATING OF AQUEOUS WASTE - PRODUCES CONCENTRATED WASTE STREAM REQUIRING TREATMENT OR DISPOSAL - REDUCES TOXICITY OF WASTE STREAM
IMPLEMENTABILITY	- EQUIPMENT COMMERCIALLY AVAILABLE - PROCESS PROVEN THOUGH CONSIDERED INNOVATIVE - MOBILE TREATMENT UNITS AVAILABLE - PILOT TESTING REQUIRED - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD
COST	NO COST DATA FOUND IN REFERENCES
REFERENCE	SITE PROFILES, EPA 1992 FEDERAL DEMONSTRATION, EPA 1993B
VENDOR	BIO-RECOVERY SYSTEMS, INC., LAS CRUCES, NM
COMMENTS	"BIO-FIX" BEADS HAVE BEEN TESTED BY U.S. BUREAU OF MINES

TABLE OU2A1

ROCKY FLATS PLANT LIST OF TECHNOLOGIES FOR OU2 GROUND WATER TREATMENT

General Response Action, Technology Type Process Option, and Description

MEDIA ABGW

CONTAMINANTS OF CONCERN Metals Radioactive Isotopes, and Volatile Organic Compounds

ENTRY NUMBER	RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	CONTAMINANTS M	P	R	V	S	O
135	AGT	THERMAL TREATMENT	LIQUID INJECTION INCINERATOR	ATOMIZING NOZZLES INJECT CONTAMINATED FLUID INTO A REFRACTORY LINED COMBUSTION CHAMBER	N	Y	N	Y	Y	Y
142	AGT	PHYSICAL TREATMENT	CENTRIFUGATION	SPINNING DRUM OR BOWL FORCES SEPARATION OF FLUIDS AND SUSPENDED SOLIDS	Y	Y	Y	Y	Y	Y
147	AGT	BIOLOGICAL TREATMENT	AERATED LAGOONS/PONDS	AERATED RESERVOIRS AND DIFFERENT MICROORGANISMS USED TO AEROBICALLY DEGRADE WASTE STREAM	N	N	N	Y	Y	Y
141	AGT	BIOLOGICAL TREATMENT	TRICKLING FILTER	WASTEWATER TRICKLES THROUGH A PACKED BED REACTOR AND CONTAMINANTS ARE REMOVED BY THE BIOMASS GROWING ON THE PACKING MATERIAL	N	N	N	Y	Y	Y
102	AGT	PHYSICAL TREATMENT	SEDIMENTATION	SUSPENDED PARTICLES ARE SETTLED OUT OF SOLUTION BY GRAVITY	Y	Y	Y	Y	Y	Y
140	AGT	BIOLOGICAL TREATMENT	WETLANDS-BASED TREATMENT	CONSTRUCTED WETLANDS USE NATURAL GEOCHEMICAL AND BIOLOGICAL PROCESSES TO ACCUMULATE AND REMOVE METALS, AND TO DEGRADE ORGANICS FROM INFLUENT WASTEWATER; PROVIDES AEROBIC AND ANAEROBIC CONDITIONS	Y	N	N	Y	Y	Y
104	AGT	PHYSICAL TREATMENT	ELECTROCOAGULATION	INTRODUCTION OF HIGHLY CHARGED POLYHYDROXIDE ALUMINUM SPECIES PROMPTS FLOCCULATION OF COLLOIDAL	Y	N	N	Y	Y	N

M Metals P-PCBs/Pesticides R-Radioactive Isotopes V-Volatile Organic Compounds S-Semivolatile Organic Compounds O-Other

AGT-Above Ground Treatment

ROCKY FLATS PLANT LIST OF TECHNOLOGIES FOR OU2 GROUND WATER TREATMENT
General Response Action, Technology Type Process Option, and Description

MEDIA ABGW
CONTAMINANTS OF CONCERN Metals Radioactive Isotopes, and Volatile Organic Compounds

ENTRY NUMBER	RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	CONTAMINANTS M P R V S O
				PARTICLES AND DESTABILIZATION OF OIL IN WATER EMULSIONS	
139	AGT	BIOLOGICAL TREATMENT	METHANOTROPHIC BIOREACTOR	METHANOTROPHS DEGRADE CONTAMINANTS AEROBICALLY IN A BIOREACTOR; METHANOTROPHS ARE BACTERIA THAT CAN USE METHANE AS CARBON AND ENERGY SOURCE	N N N Y Y N
106	AGT	CHEMICAL TREATMENT	PO*WW*ER PROCESS		Y Y Y Y Y Y
138	AGT	BIOLOGICAL TREATMENT	WHITE-ROT FUNGUS	WHITE-ROT FUNGUS HAS BEEN USED TO DEGRADE A WIDE VARIETY OF ORGANIC WASTES; ROTATING BIOLOGICAL CONTACTORS HAVE BEEN USED	N Y N Y Y Y
108	AGT	PHYSICAL TREATMENT	ADSORPTIVE FILTRATION	IRON-COATED SAND GRAINS ACT SIMULTANEOUSLY AS FILTER AND ADSORBENT	Y N Y N N N
137	AGT	BIOLOGICAL TREATMENT	ANAEROBIC REACTORS	ANAEROBIC CONDITIONS AND MICROBES ARE USED TO EITHER DEGRADE OR PRECIPITATE CONTAMINANTS USING ONE OF A VARIETY OF REACTOR TYPES	N N N Y Y Y
110	AGT	PHYSICAL TREATMENT	HIGH-ENERGY ELECTRON IRRADIATION	USE OF ELECTRON BEAM TO OXIDIZE CONTAMINANTS	N Y N Y Y N

M=Metals P=PCBs/Pesticides R=Radioactive Isotopes V=Volatile Organic Compounds, S=Semivolatile Organic Compounds O=Other
AGT=Above Ground Treatment

TABLE OU2A2

ROCKY FLATS PLANT LIST OF TECHNOLOGIES FOR OU2 GROUND WATER TREATMENT

Process Option, Effectiveness, Implementability and Cost

MEDIA ABGW

CONTAMINANTS OF CONCERN Metals, Radioactive Isotopes, and Volatile Organic Compounds

ENTRY NUMBER	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
135	LIQUID INJECTION INCINERATOR	- REMOVAL EFFICIENCIES TO 99 9% - FLUE GASES LEAVING THE UNIT MUST BE TREATED - REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT COMMERCIALLY AVAILABLE - NO UNITS CURRENTLY IN COMMERCIAL OPERATION - REQUIRES SUPPLEMENTAL FUEL - HIGH ENERGY CONSUMPTION - PERMITTING AND PUBLIC ACCEPTANCE MAY BE DIFFICULT	NO COST DATA FOUND IN REFERENCES
142	CENTRIFUGATION	EFFECTIVE FOR PARTICLE SIZES GREATER THAN 10 MICRONS - SOLIDS CAPTURE OVER 85% WITH CHEMICAL CONDITIONING - BYPRODUCT SLUDGES REQUIRE TREATMENT OR DISPOSAL - REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT READILY AVAILABLE - PROCESS IS PROVEN AND ESTABLISHED - OPERATIONS AND MAINTENANCE ARE HIGH EFFORT - FULL-SCALE APPLICATIONS ARE COMPLETED - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	FOR SOLID BOWL CENTRIFUGE WITH CAPACITY OF 10 GPM CONSTRUCTION COST $280 000 O&M COST: $ 28,000 PER YEAR (REMEDIAL ACTION EPA 1985)
147	AERATED LAGOONS/PONDS	- 50-70% EFFICIENCY - PRODUCES SLUDGE REQUIRING TREATMENT OR DISPOSAL - POLISHING STEP TYPICALLY REQUIRED - METALS MAY INHIBIT BIODEGRADATION - REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT READILY AVAILABLE - PROVEN AND ESTABLISHED PROCESS - FULL-SCALE APPLICATIONS COMPLETED - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	$100 - $350 PER CUBIC YARD (VISITT DATABASE) $30 - $600 PER TON (VISITT DATABASE)
141	TRICKLING FILTER	UP TO 90% EFFICIENCY GENERATES LARGE VOLUMES OF SLUDGE REQUIRING TREATMENT OR DISPOSAL REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT IS READILY AVAILABLE - TREATMENT PROCESS IS WELL-ESTABLISHED TREATABILITY STUDIES ARE REQUIRED TO DETERMINE IF CONTAMINANTS ARE BIODEGRADABLE	$0 50/GALLON REQUIRES HIGH CAPITAL INVESTMENT (FEDERAL DEMONSTRATIONS EPA 1993B)

MEDIA ABGW
CONTAMINANTS OF CONCERN Metals Radioactive Isotopes, and Volatile Organic Compounds

ENTRY NUMBER	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
		- METALS MAY INHIBIT PROCESS	AND RATE OF BIODEGRADATION - FULL-SCALE TECHNOLOGY - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	
102	SEDIMENTATION	- MOST CLARIFIERS ARE CAPABLE OF REMOVING 90% TO 99% OF THE SUSPENDED SOLIDS - USUALLY REQUIRED AS A PRE TREATMENT STEP FOR MANY CHEMICAL PROCESSES REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT COMMERCIALLY AVAILABLE - PROVEN PROCESS - SETTLED SOLIDS SHOULD PERIODICALLY BE REMOVED PROCESS SCALE SEDIMENTATION HAS BEEN USED HISTORICALLY - UNDER IDEAL SETTLING CONDITIONS, SEDIMENTATION DEPENDS ONLY ON THE FLOW RATE BASIN SURFACE AREA, AND PROPERTIES OF THE PARTICLE - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	FOR 1 0 MGAL/DAY PLANT CAPACITY CAPITAL COST $600 000 O & M COST $100 000 (REMEDIAL ACTION EPA 1985)
140	WETLANDS BASED TREATMENT	- 50-90% REMOVAL EFFICIENCY FOR BOD5 - UP TO 100% REMOVAL OF METALS - LOADING RATES STRONGLY AFFECT REMOVAL EFFICIENCIES - REDUCES TOXICITY AND MOBILITY OF CONTAMINANTS	- CONSTRUCTION USING STANDARD EQUIPMENT AND MATERIALS - WETLANDS TREATMENT IS AN EMERGING TECHNOLOGY - REQUIRES LARGE AMOUNTS OF LAND AREA - WETLANDS ARE AFFECTED BY CLIMATE AND TEMPERATURE - TREATABILITY STUDIES ARE REQUIRED TO DETERMINE IF CONTAMINANTS ARE BIODEGRADABLE - PERMITTING AND PUBLIC ACCEPTANCE MAY BE DIFFICULT	NO COST DATA FOUND IN REFERENCES

TABLE OU2A2

ROCKY FLATS PLANT LIST OF TECHNOLOGIES FOR OU2 GROUND WATER TREATMENT

Process Option Effectiveness Implementability and Cost

MEDIA ABGW

CONTAMINANTS OF CONCERN Metals, Radioactive Isotopes, and Volatile Organic Compounds

ENTRY NUMBER	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
104	ELECTROCOAGULATION	- EFFECTIVE FOR BREAKING UP STABLE AQUEOUS SUSPENSIONS UP TO 10% TOTAL SOLIDS AND STABLE AQUEOUS EMULSIONS CONTAINING UP TO 5% OIL - EFFECTIVENESS COMPARABLE TO CHEMICAL FLOCCULENT ADDITION BUT WITH REDUCED TIME AND SLUDGE VOLUME - METALS REMOVAL FROM 50% TO OVER 95% - SOLID PHASE BYPRODUCT REQUIRES TREATMENT OR DISPOSAL - DEWATERING FILTRATE CAN BE RECYCLED - REDUCES CONTAMINANT TOXICITY	- EQUIPMENT NOT READILY AVAILABLE - INNOVATIVE TECHNOLOGY; NOT YET ESTABLISHED - TWO YEARS OF LAB-SCALE TESTING COMPLETED - UNKNOWN INSTALLATION/O&M REQUIREMENTS - PERMITTING AND PUBLIC ACCEPTANCE ISSUES NOT ESTABLISHED	NO COSTS PROVIDED BY VENDOR
139	METHANOTROPHIC BIOREACTOR	- 80-90% REMOVAL EFFICIENCY - METALS MAY INHIBIT BIODEGRADATION - PRODUCES LARGE VOLUMES OF SLUDGE REQUIRING DISPOSAL OR TREATMENT - REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT IS READILY AVAILABLE - ONLY DEMONSTRATED AT PILOT-SCALE LEVEL - TREATABILITY STUDIES WILL BE REQUIRED TO DETERMINE IF CONTAMINANTS CAN BE DEGRADED IN A METHANOTROPHIC BIOREACTOR SYSTEM - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	$0 50/GALLON (WESTINGHOUSE SAVANNAH RIVER COMPANY) $150 - $450 PER TON (HAZARDOUS WASTE CONSULTANT MAY/JUNE 1993)
106	PO*WW*ER PROCESS	- EFFECTIVE FOR TREATMENT OF WIDE RANGE OF CONTAMINANTS NO DATA FOUND ON RESIDUAL CONCENTRATIONS OFF-GAS MAY REQUIRE TREATMENT REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT COMMERCIALLY AVAILABLE - PROCESS IS PROVEN, BUT NOT WELL-ESTABLISHED - FULL-SCALE SYSTEMS CURRENTLY ON-LINE - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	FOR 50 GPM SYSTEM CAPITAL COSTS $4 000 000 ANNUAL O&M $3 300 000 (FEDERAL DEMONSTRATIONS EPA 1993B)

TABLE OU2A2

ROCKY FLATS PLANT LIST OF TECHNOLOGIES FOR OU2 GROUND WATER TREATMENT

Process Option, Effectiveness Implementability and Cost

MEDIA ABGW

CONTAMINANTS OF CONCERN Metals Radioactive Isotopes and Volatile Organic Compounds

ENTRY NUMBER	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
138	WHITE ROT FUNGUS	- EFFECTIVE FOR TREATMENT OF WIDE RANGE OF ORGANIC WASTES - HIGH CONCENTRATION OF CONTAMINANTS MAY AFFECT THE EFFICIENCY OF THIS TECHNOLOGY - REDUCES TOXICITY OF WASTE STREAM	EQUIPMENT IS READILY AVAILABLE - PROCESS IS INNOVATIVE AND NOT WELL-ESTABLISHED - ONLY BENCH-SCALE TESTING HAS BEEN CONDUCTED - PERMITTING AND PUBLIC ACCEPTANCE NOT EVALUATED	NO COST DATA FOUND IN REFERENCES
108	ADSORPTIVE FILTRATION	- REMOVAL EFFICIENCY GREATER THAN 95% - USED IN CONJUNCTION WITH CHEMICAL COMPLEXING AND PRECIPITATION - BACKWASHING OF FILTER MATERIAL REQUIRED PERIODICALLY FOR METALS REMOVAL AND RECOVERY - REMOVES BOTH DISSOLVED AND SUSPENDED CONTAMINANTS - REDUCES TOXICITY OF WASTE STREAM	- EQUIPMENT COMMERCIALLY AVAILABLE - EMERGING TECHNOLOGY STATUS AS OF 1988 - PROCESS OPERATIONS INCLUDE EFFLUENT MONITORING AND FILTER BACKWASHING - FULL-SCALE APPLICATIONS COMPLETED - PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	CAPITAL COST FOR TRAILER PLUS UNIT (25 GPM): $150 000 O&M COST $1 50 - $2 00 PER 1 000 GALLONS (FILTER FLOW TECHNOLOGY INC)
137	ANAEROBIC REACTORS	- CAN EXCEED 95% EFFICIENCY - PRODUCES SLUDGE REQUIRING DISPOSAL AND OFF-GAS TREATMENT - POTENTIAL FOR ODOR FORMATION REDUCES TOXICITY OF WASTE STREAMS	- EQUIPMENT IS READILY AVAILABLE - FULL SCALE TECHNOLOGY - TREATMENT PROCESS IS WELL-ESTABLISHED TREATABILITY STUDIES ARE REQUIRED TO DETERMINE IF CONTAMINANTS CAN BE DEGRADED ANAEROBICALLY PERMITTING AND PUBLIC ACCEPTANCE SHOULD BE STRAIGHTFORWARD	$150 - $450 PER TON (HAZARDOUS WASTE CONSULTANT MAY/JUNE 1993) $30 $60 PER 1 000 GALLONS (VISITT DATABASE)